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Domestic horses within the Maya biosphere reserve: A possible threat to the Central American tapir (*Tapirus bairdii*)

Caballos dentro de la reserva de la biosfera Maya: Una posible amenaza para el tapir Centroamericano (*Tapirus bairdii*)

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ABSTRACT

The Central American tapir (*Tapirus bairdii*) is the largest herbivore in the Neotropics classified as "endangered." It has been proposed that Equine Infectious Anemia virus (EIA) is a disease of horses with potential to lead to further decline of *T. bairdii* populations. In this study, we used domestic horses as sentinels for EIA in the Maya Biosphere Reserve in Guatemala. In total, 40 % (13) horses tested were seropositive to EIA. This study may inform wildlife management strategies inside protected areas by considering the threat from incursions of domestic animals inside core areas of natural reserves.

Key words. Equine Infectious Anemia disease, Lentivirus, Spillover, Wildlife diseases.

RESUMEN

El tapir centroamericano (*Tapirus bairdii*) es el herbívoro más grande del Neotrópico clasificado "en peligro de extinción". Ha sido propuesto que la Anemia Infecciosa Equina (AIE) es una enfermedad de caballos con potencial de provocar una declinación de las poblaciones de *T. bairdii.* En este estudio utilizamos caballos domésticos como centinelas para AIE en la Reserva de la Biosfera Maya en Guatemala. En total, el 40 % (13) caballos evaluados fueron seropositivos a AIE. Este estudio puede orientar las estrategias de manejo de áreas protegidas, considerando la amenaza de incursiones de animales domésticos en zonas núcleo de reservas naturales.

Palabras clave. Enfermedad Anemia Infecciosa Equina, Lentivirus, Transmisión, Enfermedades de vida silvestre.

Spillover of infectious diseases (i.e., interspecific transmission) from domestic animals to wildlife occurs often but is poorly documented (Power and Mitchell 2004). Nevertheless, these events are a threat to the conservation of species with reduced populations (Craft *et al.* 2009). Furthermore, the spillover of pathogens is more frequent between species genetically related.

The Central American tapir *Tapirus bairdii* Gill, 1865, is the largest terrestrial herbivore in the Neotropics, and is classified as "endangered" by the International Union for Conservation of Nature (IUCN) Red List; populations have declined ~50 % in the last thirty years (García *et al.* c2017). Infectious diseases, combined with illegal hunting and habitat loss, are a significant threat for tapir conservation (Pedersen et al. 2007). In Mexico, transmission of diseases from horses to *T. bairdii* have been reported, mainly helminths of the genus *Trichostrongylus* (Aldán *et al.* 2006).

Equine Infectious Anemia virus (EIA; *Lentivirus* of the Retroviridae family) has been considered a potential risk for tapirs (Mangini *et al.* 2012). EIA virus is a vector-borne disease transmitted principally by hematophagous tabanid flies (Diptera: Tabanidae; Issel and Foil 1984). However, in the Atlantic Forest and Pantanal Biomes of Brazil (1996-2012), especially in the Morro do Diabo Park, 100 % tapirs (*Tapirus terrestris* Linnaeus, 1758) were found to be negative to EIA virus antibodies (May Júnior 2011, Medici *et al.* 2014). The presence of horses in the Morro do Diabo Park, however, was not reported in this study, reducing the information necessary to analyze spillover events thoroughly.

The Maya Biosphere Reserve (MBR) is considered a Mesoamerican biodiversity hotspot and has the largest tapir population in Guatemala (Vettorazzi and Manrique 2016). Monzón and Schuster (2013) reported the presence of biting tabanid flies of the genera *Tabanus* and *Chlorotabanus* in the MBR. We attempted to answer a crucial question that may help clarify the risk to EIA infection for tapirs: Is there virus circulation in domestic horses in areas where tapirs are present?

We conducted a serosurveillance in December 2012 in the MBR. The tapir population has been estimated to be ~120 individuals in the ~1,170 km² reserve (García *et al.* c2009). Horses in the reserve are used for transportation during archaeological explorations and tourist transportation from the edges to core areas of the reserve, including to the archaeological sites El Mirador and Rio Azul where tapir are present (García *et al.* c2009). We looked for prior exposure to EIA virus in horses living inside the reserve in Carmelita Community, via identification of EIA antibodies in the blood serum.

We collected 5 ml of blood from horses to obtain the serum. Serological analysis (agar gel immunodiffusion; Coggins *et al.* 1972) was conducted at the Microbiology Laboratory of the Faculty of Veterinary Medicine, University of San Carlos, in Guatemala City.

Although Guatemalan law prohibits the entry of domestic animals to core areas of natural reserves (CONAP c2001), we observed that the use of horses in the nucleus of the MBR is a common practice. From the serological survey, thirteen samples (40 %) out of the 32 collected were positive for EIA, one horse was determined suspect, and 18 were negative to the agar gel immunodiffusion test. Strikingly, our serology results show

that the horse population inside the reserve had previous exposure and possible infection to EIA, making these horses potential carriers of the EIA virus in the natural reserve. Under this scenario, risk of EIA spillover from horses to wild tapirs exists in the Guatemalan reserve. Seropositive horses were present in areas where plausible EIA vectors have been reported (Monzón and Schuster 2013).

Previous attempts to find evidence of EIA infection in wild tapir in other countries have been unsuccessful. For example, three studies attempting to identify antibodies against EIA in *T. terrestris* at three sites in Brazil had negative test results (Medici *et al.* 2014, Furtado *et al.* 2010, May Junior 2011). Thus, this virus has not been reported in individuals of the *Tapirus* genus to date (Medici *et al.* 2014). However, phylogenetic analysis within the Perissodactyla confirms the close relationship between horses and tapirs (Price and Bininda-Emonds 2009) suggesting that EIA spillover from horses to tapirs is plausible (Pedersen *et al.* 2007).

Horses spatially overlapping with the distributions of tapirs may not be new phenomena. It has been suggested that in 1519 Spaniards introduced horses into the Americas. This introduction apparently occurred in Mexico, later extending horse populations throughout the Americas (Fazio 1995). Our overall results suggest that without effective management, biodiversity reserves may not protect wildlife from disease spillover from domestic animals. We argue that infected horses should be removed from the natural reserve considering that (i) no vaccine is currently available for EIA, (ii) infected animals are potential reservoirs for their entire life, (iii) blood-sucking flies are present in the area, and (iv) there is limited understanding of the potential effects of EIA in tapirs.

AUTHOR´S CONTRIBUTION

MALL data collection, analysis, and document writing; RGA conception and document writing; NFJ document writing, GP conception and design and document writing; MG conception, data acquisition, and document writing; LEE document writing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

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